AMRAD Newsletter

AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION

P.O. Drawer 6148 *McLean, VA. USA 22106-6148* Vol. XVII - No.3

Calendar

Meetings are normally held on the second Thursday of each month at the Dolley Madison Library in McLean, Virginia starting at 7 p.m.

Thursday	Jul 12	AMRAD Meeting
Thursday	Aug 9	AMRAD Meeting
Thursday	Sept 13	AMRAD Meeting
Thursday	Oct 11	AMRAD Meeting
Thursday	Nov 8	AMRAD Meeting
Thursday	Dec 13	AMRAD Meeting

AMRAD publishes six Newsletters a year (on the first weekend of each odd-numbered month). Authors are encouraged to submit their copy by the first weekend of even-numbered months for the next Newsletter. Please submit your copy to: Editor, AMRAD Newsletter, P.O. Box 6148, McLean, Virginia 22106-6148.

New Meeting Place

The AMRAD meeting place, time and dates have been CHANGED. Take note: As of 12 April 1990, the new meeting place is the Dolley Madison Library, located in McLean, Virginia (see map). The meetings now take place on the second Thursday of each month and will start at 7 pm and end promptly at 8:55 pm. How to get there? Simple. From the Beltway: take Exit 11 North and drive 2.2 miles on Route 123 North (Dolley Madison Blvd.) toward McLean. As you cross Old Dominion Drive, you will see Charley's Place Restaurant on your right. The very next street immediately on your left is Ingleside Ave. Take Ingleside and drive about .1 mile. The library will be on your left, at the intersection of Ingleside and Oak Ridge Ave. From the District of Columbia: take the George Washington Parkway and exit at McLean. Take Route 123 South (towards McLean and Tyson's Corner). Stay on Rt. 123 for about 2.7 miles. Turn right on Ingleside Ave., drive .1 mile, until you reach Oak Ridge Avenue (the first on your left). The Library will be there on your left, at the intersection of Ingleside and Oak Ridge.

An Introduction to Flaming

by Dick Barth W3HWN

"Flaming," for those not familiar with this practice, consists of activities performed by electronic mail (typically on the Internet) which if done in person might be called "mud slinging," "raving," "blowing one's cool," or "throwing a tantrum." It requires that a modicum of fact and a maximum of opinion be loudly proclaimed in a message which is then provided with wide distribution among the target audience, usually those having interests in common with the writer. This sort of behavior is fairly common on the net and provides much of that medium's entertainment value. In ritual performances one receives formal notice of what's to come in messages of the form:

In message 23456.dingbat@foobar.edu, Joe Dingbat writes:
Quote from Joe
FLAME ON (Whoooshhh!!!) [Formal warning: send the kids to bed]
Dingbat, you're a #*%!!@ lid who couldn't tell his left foot from a DSP chip if his life depended on it! Rant! Rave! Babble!
[Additional frothing at the mouth deleted by a merciful editor.]
FLAME OFF
There. I feel better now.
(Signed) Al Hacker, AHACK@turkey.com

The "FLAME ON/OFF" notices allows those not in the mood to be screamed at, to skip such messages. Someone originating a posting (message) which is of a controversial nature and likely to trigger flames in response may also include the line:

flames >/dev/nul

at the end of the message. This signifies, in UNIX-Speak, that you needn't bother sending him flames 'cause he ain't a-gonna read 'em, let alone answer 'em. This does not, of course, deter those whose flames are posted simply for the amusement of the net rather than in anticipation of a response.

Another type of flame consists of digs taken at people, places or things without the appropriate "FLAME ON" warning. This is dangerous if done by persons alleging some expertise in the subject at hand, as it may lead the unsuspecting reader to assume that the criticism is to be taken seriously when in fact it's just another performance.

Presentations at the April 1990 AMRAD Meeting

A Synopsis

by Dick Barth W3HWN

The April 12, 1990 meeting was the first to be held at AMRAD's new digs. The relocation is the second in the past year or so, the first having come about because the Patrick Henry library, where we used to meet for many years, closed promptly at 2100 hours, (sometimes forcing an abrupt end to a presentation in progress) and because we had several times found ourselves "displaced" to another date with little advance notice. Use of the Red Cross building in Merrifield promised equally spacious accommodations with more flexible hours -- the emergency communications coordinator (a ham) held the key and any reasonable quitting time was acceptable.

As is so often the case, the promise was more than the reality. Soon after we began using the place, management of the Red Cross building changed hands and we began to find "our meeting room" full of people with plastic tubes hanging out of their arms. We met variously in the kitchen, in somebody's office, and in what had been a room but was at the time an open area full of construction debris. The night we arrived for a meeting and found NOTHING available marked the end of our association with that Red Cross building! Future meetings will take place on the second Thursday of each month at the Dolley Madison Library in McLean VA; directions are on the front page of this issue.

...

The meeting began with a discussion by Hal Feinstein, WB3KDU, of some ideas he's had for a new AMRAD project. It involves an implementation of TDMA (Time Division Multiple Access) for packet radio. The problem which prompted the project, familiar to all packeteers, is contention for time on available packet channels. In the Washington area there are typically a number of digipeaters on each channel, each receivable with varying strength at any given site, and often strong enough to inhibit transmission from a user's TNC. When the TNC does let go, there are often (usually? always?) a number of others that transmit at the same time, for a variety of reasons that may include mutual invisibility of the transmitting sites or failure of the backoff algorithm in the TNC. The result is yet another packet collision, yet another delay, and yet another failure to communicate.

TDMA is the time-sharing of a communications channel. Each potential user (transmitter) is assigned to one of a number of time slots and permission to transmit is rotated among the slots. If there are five users with traffic, then there are typically seven slots: one for each user, one for the master control station (e.g., the repeater) and one as a calling channel for others wishing to get in line. When a new caller appears in the calling channel, the master station creates another time slot, sticks the new caller into it, and advises all hands of the rearrangement.

Some implementations may also provide a "contention slot" for those stations having a small amount of traffic. They may wish to avoid the time needed to get into the queue, and instead take their chances on simply transmitting in the blind and hoping there's no collision. The contention slot permits them to do this.

What is transmitted during a time slot is not a full packet, but a certain number of bits. The message must be decommutated and reconstructed at the receiver. There is a certain amount of guard time at the front of each slot (to permit transmitters to go off or on as the case may be) but it is minimal, so each station must be prepared to turn on, talk and shut up rapidly and on time. There are various problems associated with this, including distribution of timing, the need for rapid turn-on and turn-off of transmitters, and a need for modems to synch rapidly to an incoming signal. Hal discussed various approaches to these and other problems. Those interested in participating are invited to contact Hal.

...

In the future, Glenn Baumgartner will be in charge of arranging meetings and speakers. Please contact him if you are willing to give a presentation on some appropriate subject, or if you know of someone willing to be drafted or whose arm could be profitably twisted.

...

The next speaker of the evening was Dave Borden, K8MMO whose topic was the variety of Digital Signal Processing (DSP) projects in which the amateur community is currently engaged. The presentation was occasioned by Maitland Bottoms AA4HS having found on the Internet a posting (i.e. a widely disseminated message sent to an entire newsgroup rather than to an individual) which had many of the characteristics of a flame. (For a description of a flame, see *An Introduction to Flaming* on the previous page.)

As background, Dave reminded the group that the earliest ham TNC was the "Vancouver board", designed by the Vancouver amateur packet group and built from a kit by hams throughout the U.S. for use on the two meter band. Paul Rinaldo, then AMRAD president and now editor of QST, suggested that the thing be put on HF and after repeated nagging got a few local hams to try it. A link between K8MMO and W3IWI was tried on 80 meters and worked, sort of. A Bell-202 modem, part of the Vancouver setup, is not ideal for HF use. Neither is AX.25, according to Dave, who bases his opinion on having operated an HF packet BBS for about a year, but that's another story.

The next phase was to replace the modem with a Digital Signal Processing (DSP) setup, which is to a Bell-202 as a Ferrari is to a Volkswagen. The first step was the use of a locally-manufactured commercial DSP board for which AMRAD got a good price on a group buy. A lot of software was provided by the manufacturers of the DSP chip as a means of promoting sales, and Bob McGwier N4HY wrote a lot of additional software with specific ham uses. This is all public domain and available from a number of sources, including AMRAD. Most of it has now been converted to

another DSP chip, the 56001, and sold to AEA for use in its DSP-232, according to Dave.

TAPR took McGwier's code and began to design a board around a Z80. The design reportedly made it to the prototype stage but no further; there is a chance that the design may yet make it into distribution in the form of a PC plug-in card, similar in principle to the card designed by Terry Fox of AMRAD, using a 56001, which appeared on the cover of QEX, with that issue also including an article by Dave on rapid prototyping of an IBM-clone DSP card.

ARRL proposed an HF packet modem design contest with two sections: one for single-tone modems (like PSK) and another for multi-tone modems. The League might even underwrite the cost of parts. It seems that ARRL had received a two-year $10,000 grant from FEMA for the design of an HF modem, and this would provide a means of developing it. The idea of an open contest was killed in the Digital Committee, which wanted instead to have proposals submitted so that it could fund the ones it thought sound. Proposals were solicited from those hams who were known to be working in the field of HF packeting. The solicitation paperwork included an intellectual property agreement giving ARRL all rights to the designs submitted. ARRL could then take the designs and, if they proved to have commercial value, retain the profits with nothing going to the designer. AMRAD decided not to participate.

Dave's QEX article (mentioned above) was read by Bob McGwier, who apparently concluded that the board pictured was AMRAD's entry in the ARRL contest. He then posted an Internet message discussing his own work in the field of HF modems using DSP, and noting that DRSI was about to begin delivery on a *real* PC-card DSP board. Presumably, he believed that the board on the QEX cover, designed by Terry Fox WB4JFI and built by John Teller N4NUN, was somehow *unreal* (as in square-root-of-minus-one?).

McGwier's message was somewhat critical of the rules of the ARRL modem contest, which had convinced him and others (including Dave Borden) not to participate. McGwier continued by asserting (incorrectly) that Fox's board was a contest entry, calling it a "third-rate hack", and stating that he would bar the use of any of his software by any contest participant because of the ARRL ground rules.

Subsequent to its receipt by Maitland, the message was discussed at an AMRAD Saturday-afternoon Taco session. Maitland, one of the few AMRAD members with functional Internet access, wrote and posted a reply which asserted that McGwier's message contained a lot of politics and also misrepresented issues. He argued that it was not necessary to wait for a single ideal platform before any useful work could be done on HF DSP. He noted that the AMRAD design (a) was more real than some of the others that McGwier had mentioned, (b) was the second of three prototypes, and (c) was low-cost. It pointed out further that since the AMRAD design could be perceived by some as representing a potential competitor to boards in which McGwier has a business interest, remarks about "third-rate hacks" might have to be taken with a liberal dose of salt.

Dave concluded with a mention that an out-of-town ham had written to him with an offer to assist in the project, an offer which was quickly and gratefully accepted. Additional help is needed, as are information and literature references. Anyone with useful technical data to contribute (unclassified and non-proprietary, please) are invited to send them to Dave via the AMRAD post office box. Hardware and software designers are needed; compilers and simulators are available from AMRAD.

A telephone coordinator is also needed—someone who can check the literature for work in progress then call and/or write the individuals involved to find out what they're doing and how well it works, and report to the group when something interesting is found. (Volunteers, please step forward.)

The President's Ramblings

by André Kesteloot N4ICK

Abject Apologies Dept.:

In trying to put together this issue of the Newsletter, we experienced multiple problems in the past few months. Partly because running a desk-top publishing package on the AMRAD 8088 is no fun, Bill Pala WB4NFB decided to buy a 80386 but he subsequently developed a serious software problem. By then I had myself developed a major problem of another kind: a pinched-nerve in the neck, and I came to the conclusion that life would definitely be easier if I owned a lap-top (some people will use any excuse to buy one of these cute modern-day lap-tops) hence I decided to purchase a '286. In these days of instant satisfaction, I had to wait TWO MONTHS to receive my new Bondwell laptop (80286 at 12 MHz with a 20 Megabyte hard disk). Then, believe it or not, the new desk-top package would not drive an HP DeskJet, etc., etc. Anyway, as you can see, we are finally back on track, and can only offer unlimited amounts of total, servile and obsequious groveling. We will catch up (somehow), and will try—as previously promised—to give you 6 issues per year. Meanwhile we have decided to make this issue a special one, i.e., 10 pages long, instead of the usual 8 pages. (That's a free bonus, and we hope you like it.)

Announcements:

AMRAD is pleased to announce the appointment of two additional officials to its already top-heavy management structure: Glenn Baumgartner KA0ESA has accepted the responsibility of finding appropriate speakers for our AMRAD monthly meetings, while Dave Rogers N4JGQ will, from now on, be our multifarious Secretary. Please contact the former if you know someone who would like to give a 30 minute presentation on an interesting technical subject,

and write to the latter if you have some problem with your subscription, etc.

A 4-pole Low-pass Filter For DSP Work.

Introduction: The input and output of a digital signal processor are two places where the use of low-pass filters is almost mandatory.

At the input, if the signal being processed contains a component the frequency of which is higher than the sampling frequency of the analog-to-digital (A-to-D) stage, then aliasing – the creation of unwanted low frequency artifacts – can, and thus probably will, occur. Generally, keeping in mind Shannon's theorem, one wants to limit the highest frequency component of the Fourier transform, i.e., the Nyquist frequency, to 1/2 of the sampling frequency. It is thus usual to include a very sharp "anti-aliasing" low-pass filter at the input of the DSP board.

At the other end, the sampling and D/A (digital-to-analog) processes produce discrete steps and high frequency "glitches" in the DSP output waveform. Hence a supposedly sinusoidal output often looks more like a stairstep function. Again, a low pass filter is used, this time to smooth out the unwanted abrupt transitions in the output waveform.

The present article will describe a 24 dB/octave low-pass filter built for these purposes. David Borden K8MMO uses his AMRAD DSP board for analysis of signals originating in his HF receiver, and thus needed a cut-off frequency of about 2.5KHz; while Terry Fox WB4JFI uses his AMRAD DSP board for high-fidelity audio work and wanted a cut-off frequency of about 25 KHz.

The final filter therefore includes a three-position, 4 circuit, rotary switch allowing for

a. straight-through connection, input-to-output (no filter)
b. 2.5KHz low pass 24 dB/octave filter
c. 25 KHz low pass 24 dB/octave filter

The Circuit: to obtain a large out-of-band attenuation without bulky components, active filters were selected. A review of the various types of active low-pass filters is obviously beyond the scope of this article, and suffice it to say that I chose a VCVS (voltage controlled voltage source) Butterworth "Sallen and Key" configuration because this kind of filters is relatively easy to design and implement. (See figure 1.) To simplify the design, equal values were given to R1 and R2, as well as C1 and C2. The cut-off frequency is then

$$fc = 1/(2\pi RC)$$

To protect the operational amplifier, the input signal, should it exceed 18v peak-to-peak, will be clipped to the + and - 9 volt lines by diodes D1 and D2. Good starting values for a -3 dB cut-off frequency of approximately 2.5KHz are 4.7Kohm and 10nF, but if a precise cut-off frequency is to be achieved, then the value of the resistors will have to be adjusted. Similarly, mylar capacitors of 1nF were found adequate for a roll-off of 25 KHz. The actual frequency responses of the 2.5KHz and 25KHz filters are shown in figure 2.

In this type of filter, each "pole" or "order" provides a theoretical 6dB of attenuation per octave, hence the whole circuit consisting of 4 poles in series should provide a total of 24 dB/octave. (In practice, as the curves show, a little less is achieved.)

Construction: Since two stages of amplification were needed to obtain the desired attenuation slope, I chose a LF353N/TL082 dual operational amplifier. Because of the large time-constant of the input circuit (1μFd and the two 7.5MegOhm resistors), it will, upon initial turn-on, take a couple of seconds before the circuit reaches its proper DC operating point. My version of this filter fits in a small aluminum box which also houses the two 9volt alkaline batteries. (Using batteries helps minimize hum and other noises.) All components needed to build this filter are readily available from Radio Shack and JimPack parts suppliers.

Finally, for those readers interested either in designing their own filters along different configurations, or in reading further on active filters, a good place to start is *The Active Filter Handbook* by Frank Tedeschi,TAB Books # 1133, while those interested in a very readable model of A-to-D conversion using Laplace Transforms should read an article entitled *Interfacing with C* by Howard Hutchings, pp. 591-595 in the July 1990 issue of EW + WW. (Formerly known to us Old-Timers as Wireless World.)

Happy ham-computing, and 73 DE André N4ICK.

Digital Signal Processing Development

by David W. Borden, K8MMO

10808 Mantilla Court
Oakton, VA 22124

Interest

Interest in DSP is high. Notice the new column title. Since DSP is the only amateur radio/computer thing going on in the Borden Basement Laboratory (BBL - not to be confused with BBN) lately, we might as well admit that is all I am going to write about and convince my friends to write about. We get letters (thank you, keep them coming). By the way, letters are answered here in the AMRAD newsletter and on E-Mail (daveb@wb3ffv.ampr.org) mostly. The following people wrote:

Stephen Pearce, ZL1ANY, Dunedin, New Zealand writes that he does DSP at work using a TMS320Cxx board. He uses it to analyze baby crys to detect the onset of crib death (there they call it cot death). This is a neat application. He wants to build a Fox board and wants schematics and PC board and more information.

Bob Bidecki (call not given) of Yonkers, N.Y., was nosing around the AMRAD BBS and noticed our DSP software there for the FOX board. He wants to build a board.

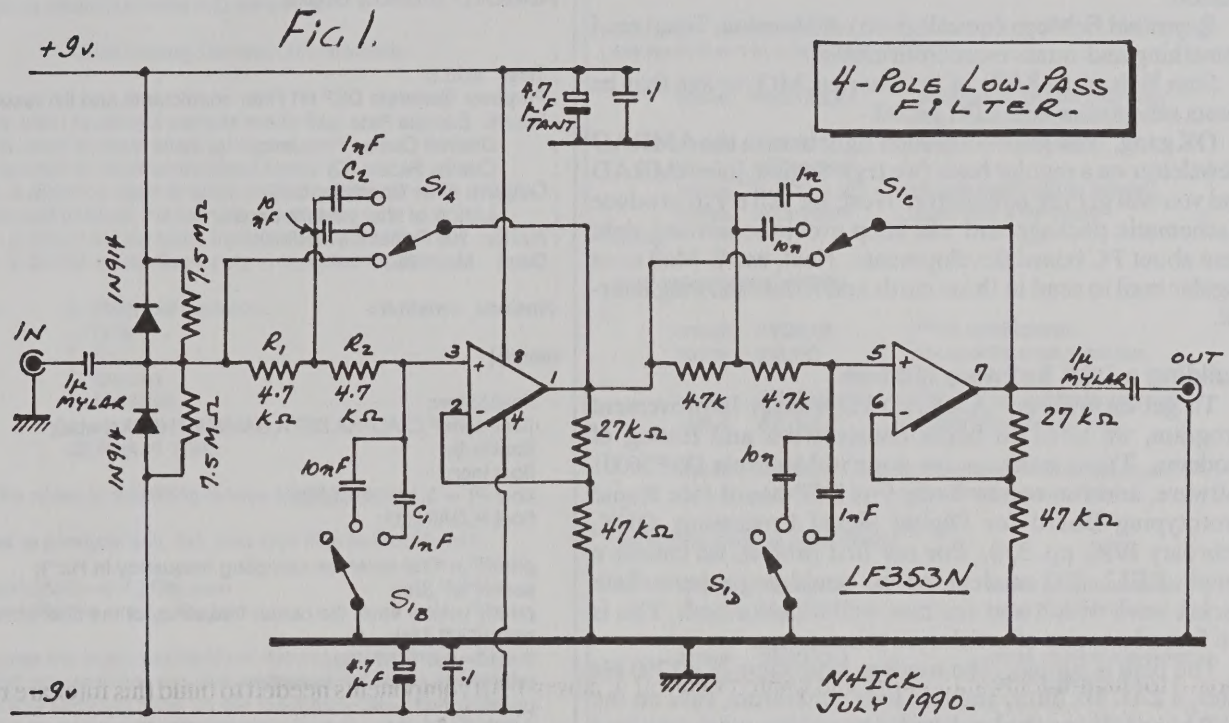
Fig 1.
4-Pole Low-Pass Filter.
+9v.
-9v
IN
OUT
1µ MYLAR
1N914
7.5 MΩ
R1
R2
4.7 kΩ
4.7 kΩ
4.7 µF TANT
.1
1nF
C2
10 nF
S1A
S1B
S1C
S1D
10nF
C1
1nF
27kΩ
47kΩ
4.7k
4.7k
10n
1n
27 kΩ
47 kΩ
LF353N
N4ICK
JULY 1990.

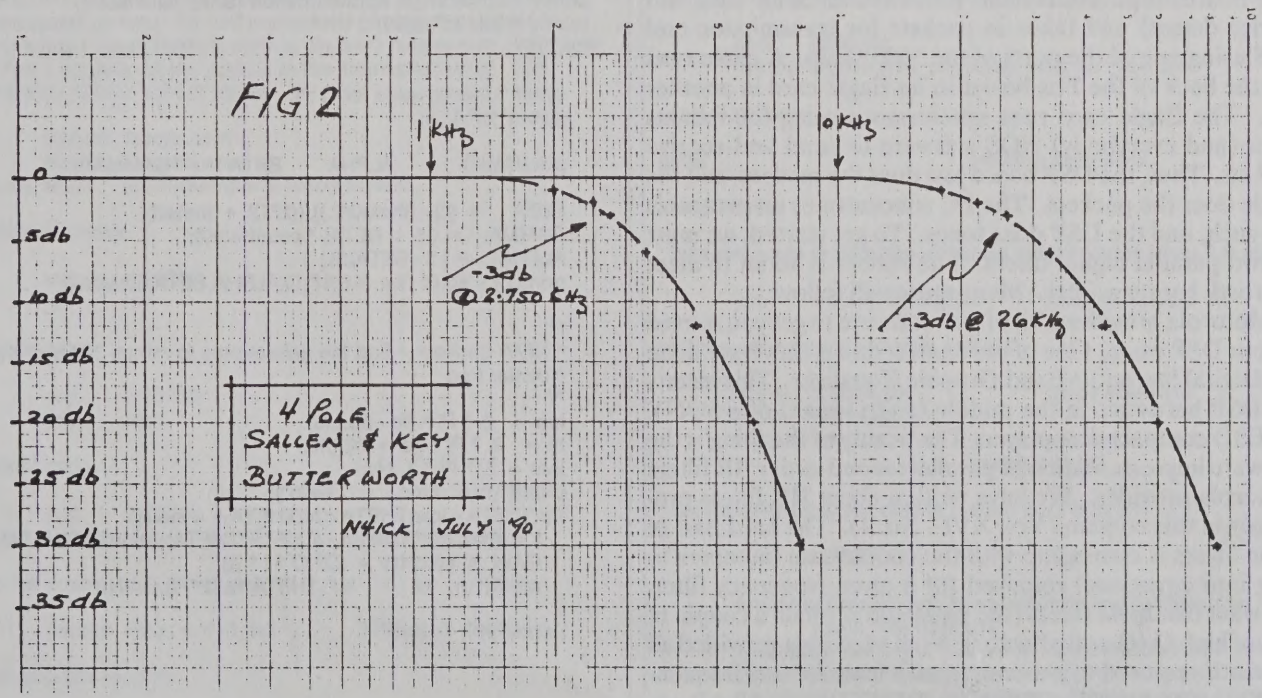
FIG 2
1 kHz
10 kHz
0
5db
10db
15 db
20db
25db
30db
35db
-3db @ 2.750 kHz
-3db @ 26kHz
4 Pole
Sallen & Key
Butterworth
N4ICK JULY '90

James Webb, WA6TQA, of Leesburg, VA, read the QEX article on Terry's board and wants to build a board and get more information.

Michael K. Hess (N3EAQ) of Absecon, N.J., read the QEX article and wants to join AMRAD and get more information.

Raymond E. Meyn (no call given) of Houston, Texas read something and wants more information.

Stan Wilson (AK0B) of St. Charles, MO, writes that he wants schematics and a PC board.

OK gang. You get information right here in the AMRAD Newsletter on a regular basis (we try). So first, join AMRAD and you will get the newsletter. Next, we will try to produce a schematic package and will keep everyone advised right here about PC board developments. Next, use E-Mail to or regular mail to send in those cards and letters showing interest.

Building a DSP Software Modem

To get on with our AMRAD HF Packet Improvement Program, we need to begin construction and testing of modems. These modems are done in Motorola DSP56001 software, and run on the Terry Fox DSP board (see Rapid Prototyping Board for Digital Signal Processing, QEX, February 1990, pp. 3,4). For our first project, we choose a simple BELL 202 modem, so we could begin immediate packet work with it and see how well it performed. This is the first of a series of articles on this modem.

The plan is simple. The modem, consisting of a 1200 Hz filter, a 2200 Hz filter, and two tone generators, runs on the DSP board. It puts out results (ones and zeros for data, and carrier detect) and takes in packets for transmission and RTS using one of the ports of the 56001 chip. A cable runs out the back of the Fox board to an Eagle card in another slot. The Eagle card runs synchronous using the famous Karn (and everybody) NOS software to send and receive packets. Thus, the DSP board just does the modem, and the Eagle does the packets. The PC concentrates on protocols and such, and the DSP does tones. To get started, we must do two parallel digital filters. The rubber is about to meet the road, here is a filter. Many more will follow:

Motorola provides a lot of free software to get you started in your DSP work. One of the neatest things they have done is a Digital Stereo 10-Band Graphic Equalizer. This inserts the DSP hardware in the middle (so to speak) of a SONY 650ESD compact disk player. The beauty of the thing is the software implementation of parallel second-order IIR filters Motorola provides. We have written about IIR filters previously in this column (Vol. XVI - No. 4). The hard part of these filters is coming up with the coefficients (numbers to plug into equations) required for a given frequency filter. We want bandpass filters (the passband is small, a couple of Hz) of high Q (Quality Factor). Well Motorola provided all the math required to generate coefficients for any frequency. So, we grabbed Hal Feinstein, WB3KDU, AMRAD approved math buff, and sat him down a computer and left him alone to mutter in his coffee. The result is a program he calls skirt.c that, given as input the A/D sample rate (you have to know this, or measure it) and desired center frequency and Q, provides the three coefficients (alpha, beta, and gamma) required to feed the 56001 software. As an extra added plus, he plots the output of the filter for you in numbers, so you can see the effect of low and high Q and other effects. Since the program is short, we will print it here and put it on the AMRAD Bulletin Board.

```
;
; Title:  skirt.c
; Purpose: Generate DSP IIR Filter coefficients and list results
; Inputs:  Sample Rate
;        Desired Center Frequency
;        Quality Factor (Q)
; Outputs: Filter Coefficients (3)
;        Listing of filter performance
; Author:  Hal Feinstein, WB3KDU
; Date:   May 1990
;
#include <math.h>

main(){

   float hi,low;
   float deltaF,Q,ALPHA,BETA,GAMMA,THETA,theta0;
   float fs,fo;
   float incr;
   float PI = 3.14159265358;
   float H,GAIN,t,t1;

   printf("\n First enter the sampling frequency in Hz:");
   scanf("%f",&fs);
   printf("\nNow enter the center frequency of the filter in Hz:");
   scanf("%f",&fo);
   theta0=2.0*PI*(fo/fs);
   printf("\ntheta0=%f",theta0);
   printf("\nfs/2  =%f",fs/2.);
   printf("\nsmall angle approximation (SAA) valid less");
   printf(" than: %f",fs/8.);
   for(;;){

      printf("\nenter value for Q :");
      scanf("%f",&Q);

      printf("\nQ        ALPHA      BETA       GAMMA");

      BETA    = (Q - (theta0/2.))/((2*Q) + theta0);
      GAMMA   = (.5 + BETA) * cos(theta0);
      ALPHA   = (.5 - BETA)/2.;
      printf("\n %3.0f  %e  %f %f",Q,ALPHA,BETA,GAMMA);

      /*
      * NOW Buckoo -- find the gain at plus to minus 30 Hz of the
      * center freq
      */
      low =  2. * PI * (fo - 30.)/fs;
      hi =   2. * PI * (fo + 30.)/fs;
      incr = 2. * PI * 3. / fs;
      printf("\n\n  Freq        Gain");
      for(THETA=low;THETA<hi;THETA+=incr){
         t = ((theta0 * theta0) - (THETA*THETA))/(theta0*THETA);
         GAIN = 1./sqrt(1 + (Q* Q * t * t));
         printf("\n  %f       %f",THETA*fs/(2*PI),GAIN);
      }
      printf("\n");
   }
}
```

Now run the program and lets make a filter. The following Motorola code implements a simple filter:

```
;*****************************************************************
```

```
;
; Program: gfilta.asm
;
; Purpose:      Take in audio sample, filter, put sample out
;
; Hardware:     Fox DSP56001 IBM PC/Clone Board
;
; Input:  16 bit Motorola serial A/D converter
;
; Ouput:        12 bit Analog Devices D/A converter
;
; Storage:
;x:$0010 is used to store a sample ready flag
;x:$001d is used to store scale up factor
;x:$001e is used to store scale down factor
;x:$0020 - x:$0022 is used to store three coefficients
;x:$01ff is used to store the sample coming in
;y:$0020 - y:$0022 stores three input samples for filter
;y:$0040 - y:$0042 stores three output samples for filter
;
; Authors:      A. Maitland Bottoms
;               J. Teller
;               T. Fox
;               D. Borden
;               H. Feinstein
;
; Date:         02 August 1990
;
; Notes: The noise in this thing is very small (no surf)
;
; the make to produce link, list, and load files looks like this:
;
;       asm56000 -b -l gfilta.asm
;       lnk56000 -c -oy:7 gfilta.lnk
;
; Gfilta solves the noise problems of the old surf program.  Fox
; found that our problem was that we were not scaling correctly.
; All incoming samples must be left justified in the 24 bit word.
; A flag tells us when a sample is ready from the serial A/D who
; interrupted us when he had completed getting the sample in.
; A one flag means there is work to do, zero means rest, don't filter.
; In Fox's version, all the code is in the interrupt routine.  This
; probably makes a lot of sense.
;
        include 'ioequl.asm'
        include 'foxioeq.asm'
SFLAG   EQU     $0010;sample is ready to filter
;
; interrupt vector
;
        org     p:$000c
        jsr     rcv
;
; reset vector
;
        org     p:$2000
        jmp     start
;
; actual code
;
        org     p:$2040
start                                   ;begin real work
;
; go full speed
;
        movep   #0,x:<<m_bcr            ;kick up to 10mips
;
; Initialize the ssi port
;
        movep   #$3000,x:m_ipr;high priority for ssi device
        movep   #$4000,x:m_cra          ;16 bit words
        movep   #$a200,x:m_crb          ;enable receive and syn mode
;
; clear out storage locations
;
        clr     a               ;get a zero into accumulator
        move    #$20,r2         ;address
        do      #$a0,xynclr     ;counter
        move                    a,y:(R2)+
xynclr
;
; set up the coefficients for filtering that you got from Hal's prog
; we want them in x:$0020 to x:$0022
;
        move    #$218d,r2       ;address of prgrm memory
                                ;filter coefficient storage
        move    #$20,r3         ;length of table is 3
        do      #3,coloop
        move    p:(R2)+,x0      ;move coefficients into x0
        move    x0,x:(r3)+      ;now into x memory
coloop
;
; stuff up registers initially
;
        move    #$20,r0         ;** iir coefficients
        move    #2,m0           ;six coefficients modulus
;
        move    #$40,r4         ;** yi(n) output data storage
        move    #2,m4           ;3 samples per output
;
        move    #$20,r5         ;** x(n) input data storage
        move    #2,m5           ;3 samples per output
;
; set up the scaling coefficients
;
        move    #$80,x0                 ;save scale-up value
        move    x0,x:$1d                ;and store it away

        move    #$800,x0                ;now save scale-down
        move    x0,x:$1e                ;and asave it also
;
; all done setup, initialize ssi interrupt and gogo agogo
;
        andi    #$f6,mr
        movep   #$01ff,x:m_pcc;okay, wait for interrupt
;
; real work loop
;
gfilta                          ;nothing fishy here
;
; loop forever
;
; take the audio in from the motorola a/d converter when it is ready
;
        jclr    #0,x:SFLAG,gfilta       ;loop till sample ok
;
; if here, we are ready to rock and roll
;
        move    x:$01ff,y0              ;copy a sample
        move    x:$1d,x0
        mpy     x0,y0,b         ;move data to d23-d12
                                ;result is in b0
;
; set for scale up when data is moved from b to x0
;
        ori     #$08,mr                 ;flame on
;
;       fefifo the filter is here, from Motorola application note
;               just a little reminder:
;       x memory starting at $20 contains 3 coefficients (r0 points)
;       y memory starting at $20 contains 3 input datas (r5 points)
;       y memory starting at $40 contains 3 output datas (r4 points)
;       b contains a sample in 16 bit twos complement
;
        move    b0,y:(r5)               ;store adc value in cyclic
                                ;buffer as x(n)
```

```
;
        clr     b       x:(r0)+,x0 y:(r4)+,y0     ;get beta and y(n-2)
                                                  ;x0=beta;y0=y(n-2)
;
        mac     -x0,y0,b x:(r0)+,x0 y:(r5)+,y0    ;b = b - beta(y(n-2))
                                                  ;x0=alpha;y0=x(n)
;
        mac     x0,y0,b         y:(r5),y0 ;b = b + alpha( x(n) )
                                                  ;x0=alpha;y0=x(n-2)
;
        mac     -x0,y0,b x:(r0)+,x0 y:(r4)+,y0    ;b=b - alpha(x(n-2) )
                                                  ;x0=gamma;y0=y(n-1)
;
        macr    x0,y0,b                           ;b = b + gamma( y(n-1) )
                                                  ;y0=gain for scaling
;
        move    b,y:(r4)-                         ;store result in cyclic
                                                  ;buffer as y(n)
;
; turn off scale mode
;
        andi    #$f7,mr                           ;flame off
;
;
; send it out the d/a converter, first dump 4 of 16 bits, leaving 12

; first scale the data back down
        move    x:$1e,y0                          ;get scaler value
        move    b,x0                              ;and the data

        mpy     x0,y0,b                           ;scale-down value
        move    b,y:f_da12                        ;send it to 12 D/A
        bclr    #0,x:SFLAG                        ;clear sample ok flag
        jmp     gfilta
;
; receive interrupt routine
;
;
rcv     movep   x:m_rx,x:$01ff                    ;actual sample
        bset    #0,x:SFLAG                        ;set sample ok flag
        rti
;
; data variables and constants
;
        org     p:$218d
;
; iir coefficients from Hal's program are stored here
;
; 400hz q=1000 sample=23000hz
;
        dc      .499945         ;beta
        dc      .0002731383     ;alpha
        dc      .993981         ;gamma
;
; all done and the fat lady sang
;
        end start
```

Now, I bet you don't think this looks like a modem. Well it is a real start! Tune in next month to see how this is done.

Direction-Finding for NASA

By Glenn Baumgartner KA0ESA

In the early spring of 1989 Dave Rogers N4JGQ attended a meeting of the Vienna Wireless Society and listened to a talk by George Griffin of NASA describing the operational and technical capabilities of the Search-And-Rescue SATellite system called SARSAT. During the course of the evening it became apparent that the old system which has been in operation for a number of years on the international distress frequency of 121.5 MHz is much easier to DF than the newer 406.025 Burst Data system.

Dave Rogers contacted other AMRAD members and in the course of several discussions contact with George Griffin indicated that there had been little done to date in the SARSAT community to find the locator beacons with portable equipment for ground search teams.

While the satellites can locate a beacon to within a mile or so, a ground search is often necessary to determine the exact location in wooded areas of the country. In case of a sea search the problem is even more severe because the beacon may be on a sinking vessel of a life-raft which is constantly being blown by the wind. Suffice it to say that there truly is a need for a direction finder capable of locating the new beacons when they become fully operational.

The direction finders used commercially and by the Civil Air Patrol (CAP) have been in use for at least 10 to 15 years and are well proven to be quite capable of finding the continuous swept tone of the low power 121.5 beacons. Unfortunately the old type of right-left homer DF sets are not readily able to handle the new signals either in frequency or type of modulation. The difficulty with the new system is caused by the short burst (600 milliseconds) PSK modulated signal and the fact it occurs only once every 50 seconds (plus or minus two seconds). This very short signal is quite difficult to successfully DF from a stationary field location and a moving DF station has only a slight advantage since the signal burst is so short and has a long quiet period between bursts.

A trip to NASA, Greenbelt, Maryland, for interested AMRAD members to find out more about the problem, was arranged by George Griffin and Dave Rogers. André Kesteloot N4ICK, Dave Rogers N4JGQ, Elton "Sandy" Sanders WB5MMB, Chuck Phillips N4EZV, and Glenn Baumgartner KA0ESA, all met with NASA officials and heard the progress to date with an effort to modify a marine VHF radio direction finder. In addition the group was afforded a tour of the NASA ground station facility which is capable of reading out the ground locations of both the present system and the newly operational 406 MHz system.

After some thought the AMRAD group decided to accept the NASA challenge to design and build a low-cost proof-of-concept direction finder capable of field use in finding the new 406 MHz beacons.

Several approaches were considered and several different working models of fairly simple left-right types of homers were built and tested. The present primary CAP direction finder was also tried with short burst transmissions. Testing led to the conclusion that while not impossible with the simpler homers, the burst nature of the new signal would

cause significant delays in finding lost aircraft or persons lost at sea. A faster, although more complex and hence more expensive technique known as Doppler direction finding was reported in an early 1987 QST article by Terrance Rogers, WA4BVY. This article and the book *Transmitter Hunting* by Joseph Moell K0OV and Thomas Curlee WB6UZZ provided convincing evidence that the Doppler technique would work satisfactorily and within reasonable cost.

With the acquisition of a Dick Smith model K-456 Direction Finder, "the hunt was on," so to speak. The basic device was extensively modified by Glenn Baumgartner KA0ESA, in part with the guidance provided in July 1989 HAM RADIO article by Joe Moell K0OV and with the addition of a pocket paging receiver recrystalled and retuned to 406.025, an audio amplifier, a 42 second timer, and an internal battery pack. The entire package, topped with an array of four monopole antennas on a copper ground plane, is mounted on a five foot pole which is carried like a large spear or medieval staff.

With the help of a NASA beacon and an AMRAD-built extremely low power test set, the system has been given numerous field trials in which it was able to give sufficient bearing information for an operator to walk, (or run) almost directly to the target beacon. Of course it is subject to difficulties with multi-path reflections as is any direction finding system but trials in open areas, hilly terrain, in wooded areas, and on obstructed paths the results have been most encouraging. While far from a perfected piece of hardened field equipment, the proof of concept device does work and was demonstrated to NASA personnel in February 1990.

Congratulations:

As we were going to press, we received news that AMRAD member James Vincent G1PVZ has been able to generate and receive Direct Sequence Spread Spectrum, in the 440MHz band, with equipment he built along the lines of the UHF Spread Spectrum link described in the May 1989 issue of QST. In the process, he identified a couple of errors which had crept into figure 6 of the QST article: the resistor feeding Vcc to U4 and U6 should be 5.6 Ohms, and not 56 Ohms. (Note that in the European system, this resistor would have been labeled 5R6, making it impossible for the draftsman to overlook the decimal point.) Also, pins 2 and 6 of U9 should be tied together, but should not go to pin 7, which is grounded. Our warmest congratulations to James for his dedication: several of us here are well aware of the numerous hurdles involved in experimenting with DSSS.

AMRAD MEMBERSHIP APPLICATION/RENEWAL

Mail to: Membership, AMRAD, P.O. BOX 6148, McLean, Va. 22106-6148

ANNUAL DUES: Regular $15; 2nd in family at same address add $8; Canada and Mexico add $2; foreign surface add $2.30; foreign air mail add $8; currency is US dollars. A donation to the WD4IWG/R repeater fund is appreciated if you use the repeater. Please make checks payable to AMRAD.

Name_____ Amateur Call_____ License Class_____

Street Address_____ Apt#_____

City_____ State/Prov_____ ZIP/PC_____

Country_____ Home Phone (___)____-_____ Work Phone (___)____-_____

Special Interest Groups: please indicate your interest.

__Deaf Communications __RTTY __Spread Spectrum __Packet Radio __Digital Signal Processing

Network: CompuServe ID:_____

_____ ID:_____

Packet Radio mail box _____ ARRL member?___

AMRAD

The Amateur Radio Research and Development Corporation (AMRAD) is a worldwide club of several hundred amateur radio and computer experimenters. It is incorporated in Virginia and is recognized by the U.S. Internal Revenue Service as a tax-exempt scientific and educational organization.

AMRAD's Purpose

The purpose of AMRAD is to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize technical forums and symposiums; collect and disseminate technical information; and provide experimental repeaters.

Meetings

Meetings are held on the second Thursday of each month at 7:00 P.M. at the Dolley Madison Library in McLean, Virginia. If the second Thursday is a holiday, an alternate date will be announced in the newsletter. Except for the annual meeting in December, meetings are reserved for technical talks - not business.

WD4IWG Repeater

WD4IWG/R is an open repeater for FM voice and digital communications, especially for experimental modes. It is located in McLean, VA. It features an autopatch available to licensed members. Frequencies are: 147.81 MHz in and 147.21 MHz out. The repeater director is Jeff Brennan, WB4WLW.

Westlink Report

The Westlink report is aired every Sunday night at 8:00PM on the WD4IWG repeater.

WB4JFI-5 Digipeater

WB4JFI-5 is a 1200-baud AX.25 Level 2 digipeater operating on 145.01 MHz. It is located in northwest Washington DC at Wisconsin Ave. and River Rd. The digipeater is mounted at an elevation of 350 feet on the south leg of the WUSA/WJLA TV tower.

Data Address

Our CompuServe/Micronet number is [72345,1050].

AMRAD Computer Bulletin Board System

AMRAD CBBS, (703) 734-1387, is operated by Lawrence Kesteloot, N4NTL. The system accepts calls at 300, 1200 and 2400 baud. The data path settings are 8 data bits, 1 stop bits, and no parity.

HEX Bulletin Board System

Handicapped Education Exchange is operated by Dick Barth, W3HWN. HEX accepts TDD/300 baud at (301) 593-7033,and 300/1200 baud at (301) 593-7357. ASCII is 8N1

Affiliations

AMRAD is affiliated with the American Radio Relay League (ARRL), Foundation for Amateur Radio (FAR), Northern Virginia Radio Council (NOVARC) and the Mid-Atlantic Repeater Council (T-MARC).

AMRAD Newsletter

The AMRAD newsletter is mailed six times a year to members and other clubs on an exchange basis. Technical articles, product announcements, news items, and other copy relating to amateur radio and computing are welcome. Honorariums of one year free membership are given for original material accepted, maximum of one year per year. Classified ads are free to members. Commercial ad inquires are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed to Editor, AMRAD Newsletter, P.O. Drawer 6148, McLean, VA 22106. Full permission for reprinting or quoting items is granted provided that credit is given to both the author and the newsletter. Membership in AMRAD is $15 annually ($8 for second member of same family). Mailing to U.S. and possessions is by 3rd Class bulk mail. Canadian and Mexican addresses add $2 for postage. Overseas readers add $8 for air mail or $2.30 for surface.

AMRAD Officers for 1990 are:

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Gerald Adkins	N4GA	Treasurer	(703) 538-6936
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